A REVIEW ON STUDY OF MULTISTORY BUILDING SUBJECTED TO BLAST LOADS

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ABSTRACT

The investigation and design of structures when exposed to explosion loads require an understanding of the air explosion phenomenon and the dynamic response of structure. Analysis of structures exposed to blast loading is difficult because the uniform transient loads produced by the nearby detonation, combined with the localized structural response results in an extremely complex structural analysis problem. Failure of one important member in the locality of the source of the blast, may generate critical stress redistribution and lead to failure of other members, and ultimately the entire structure. In this article an attempt is made to analyze a G+4 multistoried symmetrical building which is subjected to blast loading. A comparative analysis is given when the structure is fitted with X bracings, diagonal bracings. For the analysis ETABS is used along with RC Blast software. A case study is to be perform in unsymmetrical building taking the reference of our college AIET Main Building with G+4. A comparative analysis is given when the structures are fitted with different types of bracings. The plan of the building is to be drawn using AutoCAD and for the analysis ETABS is used along with RC Blast software. Computation of blast loading for G+4 storied framed building has been carried out for different cases, in which one is Normal G+4 storey building, X-Braced type building, Diagonal type braced building i.e inclination along X and Y direction. The buildings are considered as per IS Code 4991:1968 for blast resistant designing purposes. In all the cases the equivalent SEMTEX charge weight W has been taken as 50 kg and the actual effective distance from explosion R is taken as 10 m.

Keyword: *blast loading, bracings, plan, semtex, multistoried, stand off distance.*

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1. INTRODUCTION

Usually the structures will experience the blast loading owed to armed actions, unplanned outbursts or terrorist actions. These type of blast loading may result in severe destruction or failure of the structure due to their very high intensity and dynamic nature. Failure of one important member in the locality of the source of the blast, may generate critical stress redistribution and lead to failure of other members, and ultimately the entire structure.

These have led to the scheme of critically evaluating the structures against blast loading and designing them for the same. The investigation and design of structures when exposed to explosion loads require an understanding of the air explosion phenomenon and the dynamic response of structure. Analysis of structures exposed to blast loading is difficult because the uniform transient loads produced by the nearby detonation, combined with the localized structural response results in an extremely complex structural analysis problem. The investigation of structures subjected to impact loading becomes difficult, because it has to take into account the localized nature of the structure, the large variation of pressure over a relatively small area and the fact of the blast pressure not arriving at every point on the structure at the same time.

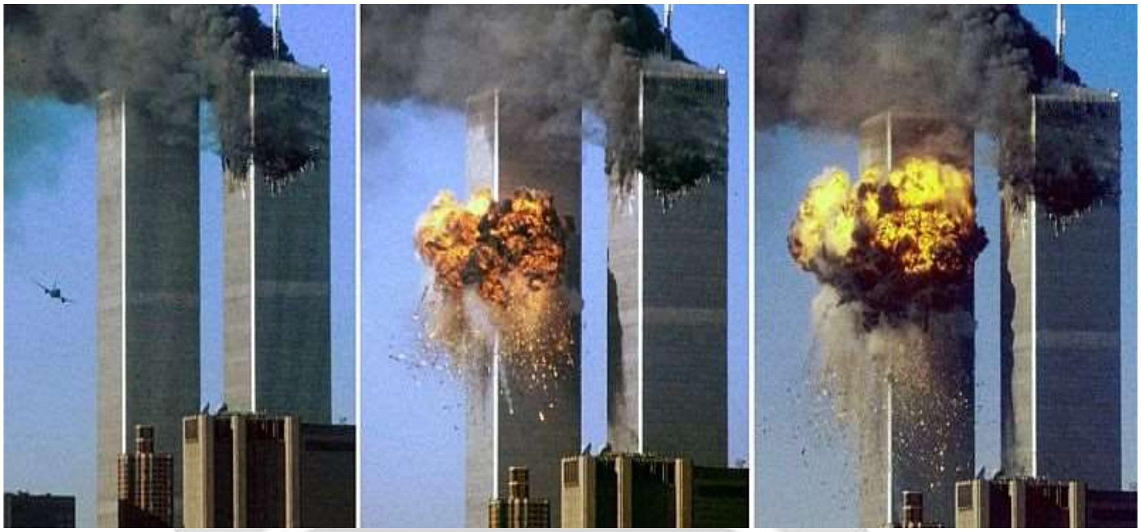

Figure 1 : World trade centre attack

1.1 About blast loading

When the blast happens, an exothermic chemical reaction takes place in a period of milliseconds. The explosive material which is in the solid form or liquid form is transformed to dense, very hot, high pressure gas. The high pressure gas or compacted air travels outward on or after the source at supersonic velocities which is called the shock wave front. This compressed air enlarges at very enormous speeds and eventually influences steadiness by means of the adjacent air. The blast features define a transient pulse of pressure which is discharged from the source of the blast The transient pulse consists of positive phase during which, incident pressure in the environment considerably go beyond the ambient pressure, often followed by a negative phase during which the incident pressure falls underneath the ambient pressure. It is the relation between the transient pulse and an affected structure which governs the dynamic response of a specific structure.

1.2 Important definitions

a) Blast wind: It is defined as the propagating air mass laterally with the over-pressure bring about from pressure alterationin arrears of shock wave front. The explosion wind movement during the positive phase of the overpressures is in the direction of shock front propagation.

b) Clearance time: The time in which the returned pressure deteriorates down to the sum of the side on overpressure and drag pressure.

c) Ductility ratio: The ratio of extreme deflection to the deflection corresponding to the elastic limit.

d) Dynamic pressure: Dynamic pressure is the pressure effect of air mass movement called the blast wind.

e) Ground zero: The point on the earth surface vertically below the explosion.

f) **Impulse:** It is the product given by the area under the pressure-time curve considered for the positive phase.

g) **Mach number:** The ratio of the speed of the shock front propagation to the speed of sound in standard atmosphere at sea level.

h) **Overpressure:** Due to the shock wave from the air blast the rise in pressure above atmospheric pressure is called overpressure

i) Reflected over pressure: The overpressure coming about because of impression of shock wave front striking any surface. In the event that the shock front is parallel to the surface, the reflection is ordinary.

j) Shock wave front: It is the gap between the blast wave and the encompassing air. It spreads far from the purpose of blast in all bearings at a velocity more than the pace of sound in the undisturbed environment.

k) Side-on overpressure: The overpressure if it is not reflected by any surface.
l) Transit time: The time required for the shock front to traverse the structure or its component under consideration.
m) Yield: It is a amount of the size of the explosion stated in equivalent weight of reference explosive.

2. LITERATURE REVIEW

2.1 Investigation Of Multistory Building subjected to Blast Load using SAP2000 Version 18,Rashmi H,T S Sahana, K.P.Thejaswi, Sachin

This study compares the response of G+6 storey building with Bare frame under blast loading and a comparative analysis is given when the structure is fitted with X bracings, diagonal bracings and V bracing. To analyze a structure for blast loading require a deep understanding of blast phenomena. The blast load was calculated by using IS code & RC Blast software. Computation of blast loading for G+6 storied framed building has been carried out for the five cases, in which one is normal G+6 storey building, X-braced type building , diagonal type braced building i.e. inclination along X and Y direction and V type braced building. In all the cases the equivalent TNT charge weight W has been taken as 100kg and the actual effective distance from explosion is taken as 20m. The blast load is analytically determined as pressure-time history and numerical model was created in SAP2000 for frame and soft storey building. The result in the form of displacement and storey drift are compared for all the different cases considered. The result shows that the displacement for the G+6 storey normal building was found to be more as compared to that of the other type of braced structure . The results are compared on different bracings provided on the structure.

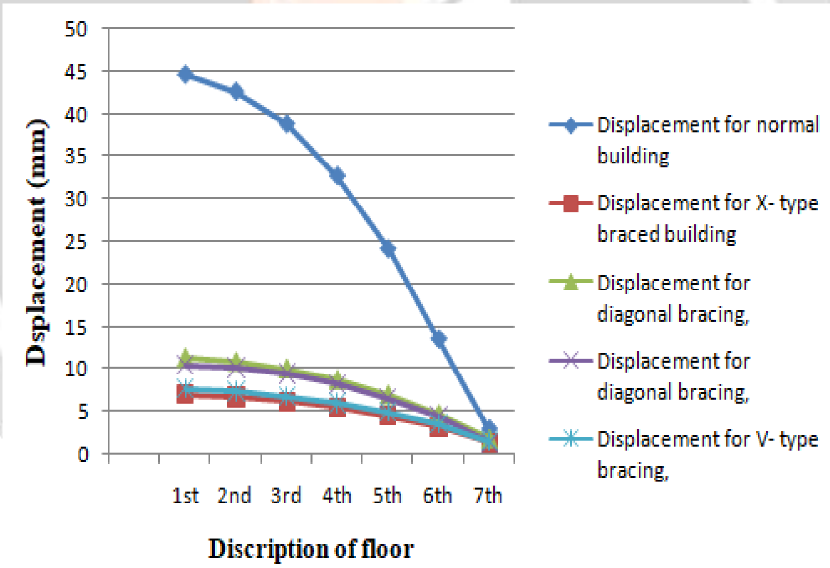

Figure 2: Graph of no of stories v/s displacement

2.2 Analysis of high rise RCC building subjected to blast load,Jiji Madonna, Mrs. Vijaya G S, and Er. Kirankumar K L

In the past few years, structures subjected to blast load gained importance due to accidental events or natural events. Generally, conventional structures are notdesigned for blast load due to the reason that the magnitude of load caused by blast is huge, and the cost of design and construction is very high. The present study is concerned with analysis of blast load considering two variations of charge weights and standoff distance. Modeling and analysis of high rise building for external (air blast) explosion. Analytically and numerically prove the behavior of tall building affected by blast. Assessing of results obtained for high rise buildings subjected to load from the analysis. In this study both regular and irregular buildings are analyzed. The blast parameters are calculated using ATBlast software. Results are compared using ETABS 2015. Columns are failed as a result failure of building geometry takes place. The most vulnerable structure is irregular building which shows highest values of Inter-Storey drift. The parameters considered in this study are joint acceleration, storey shear, inter-storey drift and storey displacements.

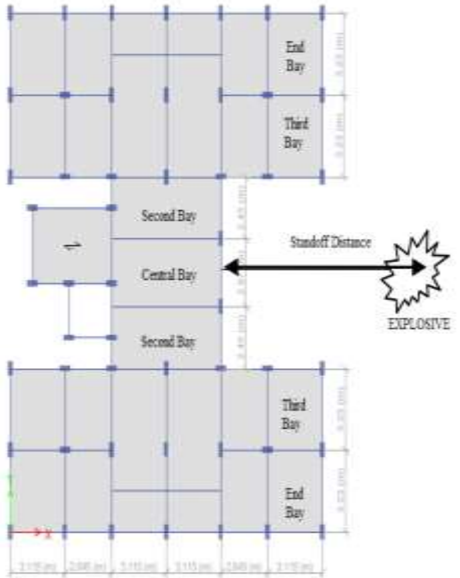

Figure -3: Typical location of explosive along Face 3 (F3)&typical layout of Irregular Building

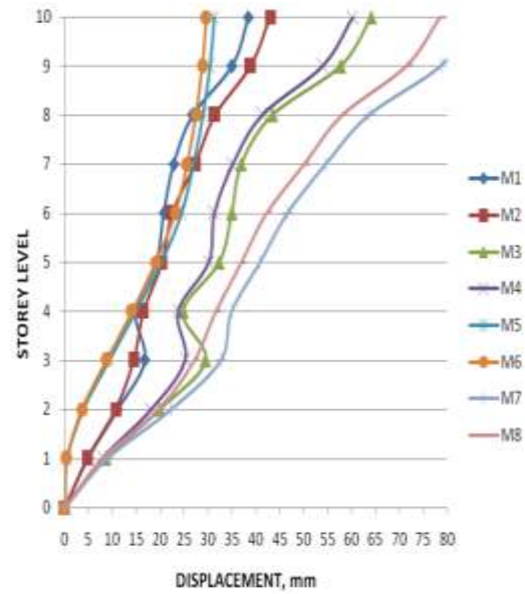

Figure 4: Storey Displacement

2.3 Blast Loading and Blast Effects on Structures – An Overview; T. Ngo, P. Mendis, A. Gupta & J. Ramsay

In this paper authors have discussed about blast effects. The examination and configuration of structures exposed to blast loads need a point by point comprehension of blast wonders and the dynamic reaction of different basic components. The paper presents an extensive outline of the impacts of blast on structures. A clarification of the way of blasts and the system of explosion in free air is given. This paper presents distinctive strategies to gauge blast loads and auxiliary reaction. For high rise offices, for example, open and business tall structures, outline contemplations against compelling occasions (bomb impact, high speed effect) is vital. It is suggested that rules on strange burden cases and procurements on dynamic breakdown anticipation ought to be incorporated into the present building regulations and configuration models. Prerequisites on pliability levels likewise enhance the building execution under extreme burden conditions.

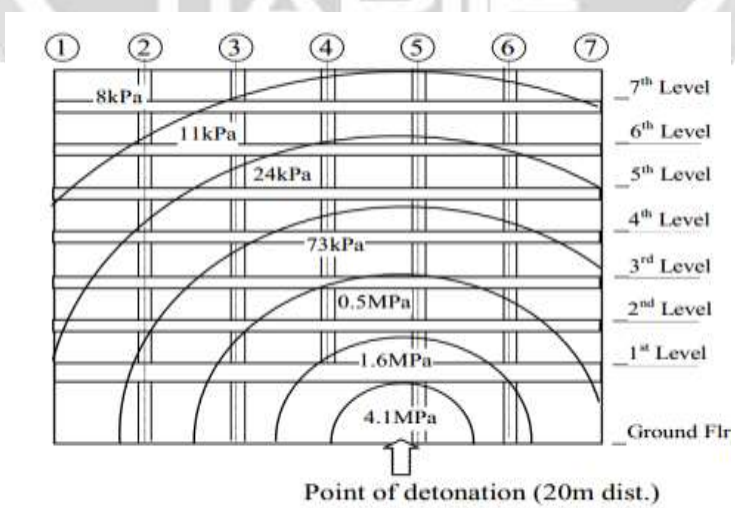

Figure 5: Distribution of blast pressure on building facade

2.4 Blast Loading on Structures, Technickivjesnik; Vladimir Sigmund,HrvojeDraganic

The paper depicts the procedure of deciding the impact load on buildings and gives a numerical sample of a fictive structure exposed to blast. Aim was to get comfortable with the issue of blast load in light of steadily developing terrorist risk and absence of rules from national and European regulations on the confirmation of structures presented to blasts. The blast load was diagnostically decided as a pressure time history and numerical model of the building was made in SAP2000. Outcomes confirm the preliminary assumption that it is possible with conventional software to stimulate a blast effects and give a preparatory evaluation of the building. The point of investigation of the structure components presented to blast load is to check their demanded ductility and contrast it with accessible ones. This implies non-linear examination is fundamental and basic plastic hinge is acceptable. Deformation of specific purpose was computed and checked against as far as possible to guage the post-impact condition of the component. The elements exposed to explosions, conventional reinforcement provides sufficient ductility, while for close explosions additional reinforcement is required.

Vehicle Type	Capacity mass / kg
Compact car trunk	115
Trunk of a large car	230
Closed van	680
Closed truck	2270
Truck with a trailer	13610
Truck with two trailer	27220

Table 1: Estimated quantities of explosives in various vehicles

3. CONCLUSIONS

In summary, Contribution factor of 0.25 is considered for outer nodes but for inner nodes it is taken as 0.5 at the ground level and at the top floor, whereas the contribution factor of 0.5 is considered for outer nodes and for inner nodes it is taken as 1 for all other floors. Therefore at the outer nodes the application of blast load is lesser compared to that of the inner nodes. As the positive pressure decreases the time taken for the blast load to reach the structure also decreases. The displacement for the multistorey normal building was found to be more as compared to that of the other type of braced structure. Among all the braced type of structures the X-type bracing is found to be efficient when the blast load was applied laterally. For the normal storey building the displacement was found to be high whereas in case of X-type bracing the displacement was found to be low. Subsequently X-type bracing showed less displacement compared to other two type of diagonal bracing, the displacement was found to be more safe in X-braced symmetric and non-symmetric buildings.

4. REFERENCES

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